IFF/SIF OPERATIONAL PROCEDURES

ACP 160(C)

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2. ACP 160 (C) is effective on receipt for CCEB Nations and when by the NATO Military Committee (NAMILCOM) for NATO nations and Strategic Commands.

EFFECTIVE STATUS

Publication	Effective for	Date	Authority
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3. All proposed amendments to the publication are to be forwarded to the national co-ordinating authorities of the CCEB or NAMILCOM.

For the CCEB Principals

W QUENNELL
Squadron Leader
Permanent Secretary to CCEB

RECORD OF MESSAGE CORRECTIONS

Identification of Message Correction and date of same		Date Entered	By whom entered (Signature; rank, grade or rate; name of command)
Date, Time Group	Correction		

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CHAPTER 1

GENERAL INSTRUCTIONS

101. PURPOSE

The purpose of this publication is to briefly describe IFF systems and to provide a basis for establishing operational procedures and equipment policy. More specialist/technical information and operational procedures may be found in national or regional defence organisation publications. IFF systems have been adopted for the primary function of assisting in the rapid and positive identification of friendly units and secondly, assisting in the tracking and control of aircraft. Although considered an identification device, IFF systems are normally used in conjunction with other means (eg radars, flight plan correlation, voice authentication, and so forth) to provide identification of friend or foe.

102. SECURITY CLASSIFICATION

a. IFF equipment and related technical information is UNCLASSIFIED, with the exception of technical data on security equipment for Mark XII, which is CONFIDENTIAL.

b. Documents containing information on the tactical use of IFF equipment (including doctrine and procedures) will be classified SECRET.

c. Documents containing guidance (including doctrine and procedures) for only non-tactical (for instance Air Traffic Control, Air/Sea Rescue) employment of IFF systems will be UNCLASSIFIED.

103. OBSERVATION OF SELECTIVE IDENTIFICATION FEATURE (SIF) RESPONSES

All operators of IFF interrogation equipment must be highly skilled in recognising and interpreting SIF responses as displayed on their equipment whether computerised or manual. In particular, operators should appreciate the distinction between Normal, Identification of Position (IDENT I/P), and Emergency responses.

CHAPTER 2

IFF SYSTEMS

201. INTRODUCTION

The purpose of this chapter is to provide an unclassified description of the IFF systems in current NATO service and those being introduced into Service in the near future. Table 2-1 provides a summary of all these systems, including the facilities that they provide.

202. BASIC IFF MARK X SYSTEMS

Basic Mark X is the oldest IFF system still in operational use by friendly nations. It has the ability to reply by mode only (no codes are available from the transponder). IDENT (I/P) and EMERGENCY features are available. A LOW receiver sensitivity position is also available. Certain nations restrict the use of the basic Mark X transponder equipped aircraft.

203. IFF MARK X (SIF)

To improve the flexibility for operational use of the basic Mark X system, the Mark X (SIF) was adopted. The SIF adds reply pulse coding to the basic Mark X system and provides added capability for performing identification, and the tracking and control of friendly aircraft. The SIF addition to the basic Mark X, because of its low inherent security, does not provide positive identification of friend or foe. The numbers of codes available from the Mark X (SIF) equipment are 32 in Mode 1, 4096 in Mode 2, and 64 in Mode 3. IDENT (I/P) and EMERGENCY features are also available.

204. IFF MARK X (A)

Mark X (A) is essentially the same as Mark X (SIF) except that Mode 3 provides 4096 codes and Secondary Surveillance Radar (SSR) Mode C, which provides for automatic pressure altitude reporting.

204. IFF MARK XII

Mark XII is essentially the same as IFF Mark X (A) but has the addition Mode 4, which provides for secure positive friendly identification.

205. IFF MARK XII (S)

Mark XII (S) is the same as IFF Mark XII but has the addition of Mode S (Select). Mode S is a civil aviation initiative to overcome deficiencies associated with SSR Mode 3/A and C. It provides unique aircraft identification, enhanced Mode C height resolutiona and flight details through the transmission of Downward Air Parameters (DAPs).

206. IFF MARK XII (A)

Mark XII (A) has the same features as IFF Mark XII and the additional capabilities of the secure Mode 5 waveform. Mode 5 provides 4 graduated levels of data transmission with

enhanced security protection. Mode 5 has 4 graduated levels of capabilities; Level 1 provides a Question and Answer Identification (including a unique Platform Identification Number (PIN) and a classified 'LETHAL' interrogation format), Level 2 Position Reporting, Level 3 Selective Interrogation and Level 4 Data Exchange.

TABLE 2-1

IFF SYSTEMS

BASIC IFF MARK X	IFF MARK X (SIF)	IFF MARK X (A)	IFF MARK XII
Mode 1	Mode 1 - 32 Codes	Mode 1 –32 Codes	Mode 1 –32 Codes
Mode 2	Mode 2 – 4096 Codes	Mode 2 - 4096 Codes	Mode 2 - 4096 Codes
Mode 3	(not normally selectable in flight)	(not normally selectable in flight)	(not normally selectable in flight)
	Mode 3 - 64 Codes	Mode 3 - 4096 Codes	Mode 3 - 4096 Codes
			Mode 4 - secure mode
		SSR Mode C	SSR Mode C
IDENT (I/P)	IDENT (I/P)	IDENT (I/P)	IDENT (I/P)
EMERGENCY	EMERGENCY	EMERGENCY	EMERGENCY

IFF MARK XII(S)	IFF MARK XII (A)
Mode 1 –32 Codes	Mode 1 –32 Codes
Mode 2 - 4096 Codes	Mode 2 - 4096 Codes
(not normally selectable in flight)	(not normally selectable in flight)
Mode 3 - 4096 Codes	Mode 3 - 4096 Codes
Mode 4 - secure mode	Mode 4 - secure mode
SSR Mode C	Mode 5 - secure mode, PIN
SSR Mode S	SSR Mode C
DAPs (Downward Air Parameters)	
IDENT (I/P)	IDENT (I/P)
EMERGENCY	EMERGENCY
	LETHAL

CHAPTER 3

IFF/SIF COMMON OPERATING CHARACTERISTICS

301. DESCRIPTION

a. Introduction. IFF systems consist of interrogators, transponders, processing equipment, and related antenna systems. The antennas may or may not be associated with, or slaved to, a primary surveillance radar. In operation, an interrogation pulse pair or pulse train transmitted from the interrogator transmitter unit triggers each transponder located in the direction of the main beam causing a reply to be transmitted by the transponders. These replies are received by the interrogator receiver and, after processing, are displayed to the operator. Measurement of the time between transmission of the interrogation pulse and receipt of the transponder reply determines the range of the replying transponder while the mean direction of the main beam of the interrogator antenna, during the reply, determines the azimuth. The arrangement of the multiple-pulse reply provides identifying information and, in certain cases, pressure altitude of the responding aircraft.

b. Modes. To differentiate between interrogations for different purposes, several modes of operation have been adopted. Technical details of civil modes are contained in Annex 10 to ICAO Convention. Technical details of military modes are contained in national and regional defence organisation documents. In the military environment, there are five modes of operation known by Arabic numerals as Modes 1 through 5. In the Civil Air Traffic Control environment, IFF is called Secondary Surveillance Radar (SSR). The civil modes are known by letter designators as Modes A, B, C and D. The basic civil SSR mode is Mode A and is identical in most characteristics to the military Mode 3; as a consequence, this mode is commonly referred to as Mode 3/A. Modes 3 and A differ mainly in the characteristics of their EMERGENCY response. The second civil SSR mode is Mode B, which has very limited usage and has no military equivalent. Mode C is reserved for automatic pressure altitude transmission. Use of the fourth civil SSR mode, Mode D, has not been determined internationally. Military Modes 1, 2, 4 and 5 are not used in the civil SSR system. An additional civil Mode called Mode S is being developed. This is designed to use selective interrogation only and is expandable to include Downlink Aircraft Parameters.

c. IDENT Functions. In addition to selecting the mode to which the transponder will reply and the code setting within that mode, aircrews can add to the reply. One addition is the I/P or Special Position Identification (SPI) feature. When selected in Mode 1, two pulse trains containing the code in use are transmitted. When selected in Modes 2 or 3, this feature activates the transmission of an additional pulse 4.35 microseconds after the last framing pulse.

d. EMERGENCY Feature. The EMERGENCY response feature may be selected by the aircrew to cause the transponder to reply to any mode of interrogation with a distinctive reply of four pulse trains spaced 4.35 microseconds between trains. In more modern IFF systems, the EMERGENCY response feature of the 4096 code capable Mode 3/A radar beacon system will be coded 7700 for civil aircraft in all

responses and 7700 in the first train of a four-train response for military users. Many existing military transponders (Mark X) (SIF) may transmit Code 000 for the last three trains. Mark XII Mode 3/A will provide Code 7700 in the first train followed by three trains of Code 000. Additionally, Code 7600 shall be used on Mode 3/A to provide recognition of an aircraft with radio communication failure. Code 7500 shall be used on Mode 3/A to provide recognition of an aircraft has hijackers on board.

302. OPERATION

a. The following modes of operation have been adopted for world-wide use:

(1) Mode 1. Known as the General Identification Signal and beacon assist. In older transponders, Mode 1 is automatically selected for transmission when the transmitter is turned on. In more modern transponders, Mode 1 is available by switch setting. When SIF is available, aircrews can select any one of 32 reply codes.

(2) Mode 2. Known as the individual identification mode. Aircrews can select whether or not the transponder will reply to mode interrogation. Mode 2 code selection is not readily aircrew selectable. There are 4096 codes available.

(3) Mode 3. Aircrews can select by switch setting whether or not the transponder will reply to Mode 3 interrogation. Within Mode 3 are 4096 available reply codes. However, some older equipment has a reduced capability in Mode 3 of only 64 codes.

(4) Mode 4. Provides for positive secure friend identification. Mode 4 may be switched in or out by the aircrews in accordance with operational requirements.

(5) Mode 5. Provides enhanced secure friend identification. Mode 5 may be switched in or out by the aircrew in accordance with operational requirements. Each platform will be assigned its own unique PIN.

(6) Identification of Position (I/P) or Special Position Identification (SPI). There are three available switch settings within this function. IDENT (I/P)-OUT - MIC. Transponders are normally operated with this switch in the OUT position. The switch is spring loaded so that it returns to the OUT position when released from the IDENT (I/P) position. When activated in the IDENT (I/P) position, the transponder replies with a special response for each interrogation. This condition continues for from 15 to 30 seconds after release of the switch, after which the transponder will reply with a normal response. The MIC position operates in the same manner as the IDENT (I/P) position, for instance, whether MIC is selected and the pilot's microphone switch is depressed, the transponder replies with a special response lasting for from 15 to 30 seconds. In those aircraft in which the MIC position is not interconnected with the radio transmitter, this position has no function.

(7) EMERGENCY (Distress) Feature. This signal response is selectable by transponder switch setting. When selected, it will cause the transponder to reply to each interrogation with four pulse trains spaced 4.35 microseconds between trains. This provides a distinctive display for recognition by operators at the interrogating location. EMERGENCY transponder replies will continue to be transmitted with each interrogation until the aircrew changes the switch setting. While the selection of the emergency signal by the aircrew will cause the transponder to reply, in the appropriate manner, there are times in which the signal can cause erroneous indications at the interrogating location (for instance, when tracks cross at different altitudes). Therefore, the Mode 3/A EMERGENCY response feature will include the use of certain code settings to insure recognition of the emergency at all times. The code selected will be 77 or 7700, depending on the type of transponder. Code 76 or 7600 is reserved for recognition of an aircraft with radio communications failure. Code 7500 shall be used on Mode 3/A to provide recognition of an aircraft having hijackers on board.

b. LOW Position (Transponders.) The LOW position can be selected for operation of the transponder. This setting reduces the receiver sensitivity of the airborne transponder, thus reducing the reply rate. Transponders will be operated in LOW position upon direction of the controlling agency or in accordance with local directives. Although the majority of transponders in operation have the LOW position available, certain modern transponders and interrogators have side lobe suppression (SLS) and beam sharpening methods available that eliminate the need for a LOW position.

c. Surface Transponders. Controls for ground and surface transponders are very similar to airborne transponders except that EMERGENCY, IDENT (I/P) and Mode C may be omitted.

d. Codewords. The codewords used to manage operational use of IFF equipment are detailed at Table 3-1 and are derived from ACP 165 (F).

TABLE 3-1

IFF SYSTEM CODE WORDS

CODE	**MEANING**
PARROT	Military IFF transponder
SQUAWK(ING)	Operate IFF as indicated or IFF is operating as indicated for instance SQUAWK THREE CODE ZERO ZERO AND IDENT
SQUAWK MAYDAY	Turn IFF Master Control to EMERGENCY
SQUAWK IDENT	Activate IFF transponder I/P switch
SQUAWK MIKE	Place IFF switch to MIC. Make a short radio transmission
SQUAWK LOW	Turn IFF Master Control to LOW sensitivity position
SQUAWK NORMAL	Turn IFF Master Control to NORMAL
SQUAWK STANDBY	Turn IFF Master Control to Standby
SQUAWK FOUR	Turn mode 4 switch on
STRANGLE	Switch off equipment indicated
……. SOUR	Equipment indicated is not operating efficiently
……. SWEET	Equipment indicated is operating efficiently
……. BENT	Equipment indicated is inoperative. Cancelled by OKAY

CHAPTER 4

TECHNICAL SPECIFICATIONS

401. GENERAL

Detailed technical specifications of IFF/SIF equipment and instructions for its use are contained in appropriate Military Service publications and in ICAO Annex 10 for Air Traffic Control application. Only those technical specifications of use to operators of IFF/SIF systems are included here.

402. BASIC IFF MARK X

The basic Mark X transponder reply for Modes 1 and 3 is a single pulse. The Mode 2 response for aircraft is two pulses with 16-microsecond spacing. All basic Mark X transponders transmit Mode 2 information when the transponder is in LOW or NORMAL operation.

403. IFF MARK X (SIF)

When coding is added to basic Mark X transponder equipment, the replies are changed into pulse trains, consisting of two framing or bracket pulses spaced 20.3 microseconds apart. Contained within these framing pulses is a series of up to 12 short (.45 microsecond) information pulses, the presence or absence of which is determined by code selection in the transponder equipped vehicle.

a. Mode 1 operation of the transponder uses up to five information pulse positions spaced 2.9 microseconds apart.

b. Mode 2 operation of the transponder utilizes combinations of pulses out to a maximum of 13 pulse positions with a spacing of 1.45 microseconds, the seventh pulse position always being omitted. Certain Mark X (SIF) transponders transmit Mode 2 information when the transponder is LOW or NORMAL operation.

c. Mode 3 operation uses up to six information pulse position spaced 2.9 microseconds apart.

404. IFF MARK X(A)

Mark X(A) is essentially the same as Mark X (SIF) except that Mode 3 operation of the transponder provides 4096 codes made possible by using additional combinations of pulse positions. Mark X(A) transponders are also Mode C capable of providing automatic pressure altitude reporting. Certain Mark X(A) transponders have a Mode 1 on and off switch.

405. IFF MARK XII

The Mark XII system contains all features of Mark X(A) with two additions. The primary addition is Mode 4, which provides a security coded response to suitably equipped interrogators. The Mark XII transponder also has an aircrew control Mode 1 on and off

switch whereas most basic Mark X and certain Mark X (SIF) transponders always transmit Mode 1 information when the transponder is in LOW or NORMAL operation.

406. IFF MARK XII (A).

a. The Mark XII (A) system provides all features of Mark XII with the addition of Mode 5, which provides an enhanced security coded response to suitably equipped interrogators. Mode 5 employs spread spectrum data modulation, a spectrally efficient RF modulation technique known as minimum shift keying, higher capacity/ATC friendly waveforms and new cryptographic algorithm and security features with Time of Day authentication.

b. There are four levels of operation. Level 1 provides 2 reply waveforms. The ID reply provides secure, positive friend identification only. The Data Reply provides 28 information bits, which will include the PIN of 14 bits. Level 2 adds a position reporting capability to the basic Level 1 Q&A mode. Each Level 2 reply contains latitude and longitude information along with format dependent reply data shown in Table 4-1. The technical characteristics of Levels 3 and 4 have not been fully defined.

TABLE 4-1

Data Field
Mode 1
Mode 2
Mode 3
Barometric Altitude
Mission Code
National Origin
Platform Identification Number
Emergency
Identification of Position
X Pulse

CHAPTER 5

RESPONSIBILITY

501. COMMANDERS' RESPONSIBILITY

a. Commanders are responsible for ensuring that personnel under their command concerned with IFF operation are cognizant of these instructions and that they are fully disseminated, thoroughly understood, and properly employed.

b. The primary function of IFF systems is to assist in the rapid and positive identification of friendly units and secondly assisting in the tracking and control of aircraft. Tests and studies have revealed that IFF systems may suffer degradation due to interference in areas of high aircraft density and large numbers of interrogations. Commanders will therefore ensure that agencies under their command will not operate IFF interrogators except for the express purposes explained above without specific authority from the appropriate Theatre or Area Commander.

c. In exceptional cases, necessary maintenance, operational checks, and evaluations may be performed on the IFF interrogators. Commanders will ensure IFF/SIF equipment is maintained in a manner to allow immediate operational use. Equipment may be used in exercises as required. However, such use must be kept to a minimum.

d. Commanders will ensure that exercises that employ IFF systems are co-ordinated in advance, with host nation, or host nations, IAW established policies and procedures (eg Germany requires co-ordination in advance, to be followed up with quarterly reporting for Mode 4).

e. Commanders are responsible for effecting operational control in a manner allowing for the performance of the Air Traffic Control function.

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